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INTELLECTUAL INTERCHANGE AMONG FACULTIES OF ENGINEERING SCHOOLS[1]

By Professor DUGALD C. JACKSON

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

A MAN who becomes over-trammelled by rules, precedents and tradition will always remain a commonplace man. One who breaks precedents and tradition seldom is a commonplace man, and from such usually come the helpful leaders or notable criminals. The ones who break conventional rules with convincing service to fellow men and without injury to the social organism are the leaders. An instinctive ability to recognize the times and places when usual conventions ought to be observed, and when progress may be better achieved by breaking their shackles, is evidence of originality and creative vision. These qualities should be more fully cultivated in the faculties of engineering schools, and their evolution made a matter of our earnest mutual concern.

It is interesting to reflect on the erroneous conventions and traditions which came to us from the Victorian era and which have biased the thinking of the present generation. For example, it is still sometimes individually believed and taught (because of Victorian tradition) that the Periclean period in Athens was the golden age of the world. Nevertheless, it probably was the orgy of exploitation and spending by Pericles and his party which brought ancient Athens to the brink of its downfall with resulting increase of sorrow and hardship for all the population, from the highest citizen to even the lowliest slave. Thinking of that period as a golden age for humanity, whatever its triumphs of sculpture and architecture, exhibits a failure to inquire and explore beneath a surface aspect which is deceptively polished and graceful. This deficient procedure is not appropriate to education which is to serve for the best interest of civilized society or its individual human components.

[1] Address before Society for the Promotion of Engineering Education, in Engineers' Week, Chicago, Illinois, June, 1933.

In our level of engineering education, and perhaps in all levels, teaching that is instruction without having associated with it the spirit of inquiry is bad pedagogy. That is, the practise of research is a vital part of engineering education. But research which is carried on in guarded chambers to avoid student contacts does not contribute to educational processes and may not be appropriate to engineering schools, although its discoveries ultimately may contribute to social welfare. Similarly, educational processes almost always become conventional and unvital if the processes are prevented from securing infusions of ideas from outside, whether this prevention is due to lack of enterprise or to intent.

Perhaps engineering education, being established in an expanding and interestingly changing field, may be less subject to devitalization and conventionality than education in some other fields of learning; but we all are aware nevertheless of the ease with which teaching can become conventional or even perfunctory. It particularly rests with those who work in the expanding and inspiring atmosphere of applied science to avoid conventional and uninspiring processes. Out of this concept springs another element in the importance of maintaining constant interrelations between all engineering school faculties and of making interchanges of studied views on educational problems.

The distinguished accomplishments of this society through its Board of Investigation and Coordination and other committees, in expounding the trends of engineering practise, the processes of engineering education and the character of personnel appropriate to teaching staffs for the engineering schools, lay upon us who are in the teaching ranks a peculiar and exalted responsibility to make the most of opportunities that are thus shown to be within the reach of our hands. Reports of our situation and suggestions for procedures are definitely before us. It is for us as individuals and as faculty groups to bring farther fruit from the vineyard thus planted.

Professional distinction in the engineering field is supported on wise vision of the profession concerned, sound and independent judgment and deeply rooted learning. This calls for talent, and it also calls for industry, energy, originality and resourcefulness. The slavish follower after habit and tradition is sure to be left behind in this, as in any other, creative employment or profession.

Engineering is an affair of human welfare and those employed in engineering education must bear this in mind. Seekers after romance who "stand knee-deep in indolence" can not rise to the high offices thrust upon a correctly chosen engineering teacher. Intellectual indolence is an irretrievable fault in any such. We conceive the life of the engineer as a high calling, and ask others to so conceive it, because (among other things) all those spiritually impelling activities which afford us means of distant transport of body or intelligence from place to place and from person to person are engineers' contributions to civilization. The railroad, the steamship, the highway, the telegraph and the telephone provide statesmen with instrumentalities through which the substantial kinship of all the world some day may be established. Electric transmission of power and artificial lighting contribute substantially to ease and comfort in civilized life. Still fuller cooperation among applied scientists may yet become one of the wonders of the world and out of it arise benefits to mankind as yet undreamed. Even the health of individuals may become completely safeguarded by discoveries made possible by the joint application in the medical field of the learning of physiologists and the accurate instrumentalities for measurement which spring from the learning of engineers.

These illustrations point to the fact that further engineering achievements need not be assumed to be limited solely to improvements of existing instrumentalities utilized by society, but may be visualized as also including additional influential discoveries and inventions. With the development of civilization and its accompaniment of an organized society possessing protective agencies guided by the hand of a definitely established central authority, instrumentalities for communication between individuals and between communities take the place of instrumentalities of exclusion. Thus the building of walls to surround living places with intent to prevent enemy ingress but which also result in a decrease of mutual access between friends has ceased in the present era and the building of roads which increase access between peoples and contacts among the individuals has become widespread. Such great changes in living conditions (of which there are many), and equally great changes in the level of civilized thought, result in corresponding changes in the aims and the achievements of education.

The utilization of natural forces for the benefit of mankind has been the result of engineering originality and resourcefulness continued through the entire period of recorded history. The first such utilization presumably arose from crude observations of natural phenomena by some independent-minded person with curiosity and a love of economy, that is, an inventor, who was thus in a single embodiment the original scientist and the designer of the applications. Many ages afterward there came a period in which research in science became an end in itself, thereby bringing additional precious facts to the hands of engineers in addition to those which the engineers themselves had time to detect. Now we still farther develop this

specialization between the so-called pure scientist and the engineer or applied scientist; and we also combine the two functions, in coordinated fashion and in the hands of combination groups, for seeking out new facts and discovering new applications.

In order that mankind may be guided to use most desirably the great powers now at its command as the result of the applications of science, it is needful for engineers to inform themselves in the principles of political economy and psychology, in addition to the principles of chemistry, physics and mathematics which are universally recognized as part of an engineering curriculum. These principles of political economy and psychology which are studied ought to be just as fundamental as the principles of the older sciences, but unhappily they have not yet been so formulated. Progress in this direction for political economy perhaps has been delayed by the fact that many of its teachers have sought the life of contemplative philosophers, while political economy is a dynamic entity associated with the changing social organization and therefore must be studied from the applied, experimental aspects.

Engineers carrying forward the front of applications of new discoveries are dealing with a growing field, full of changes, which can not be mastered wholly through philosophical bookishness and contemplation. However, they are not fleeing from the past like the family of Lot from Sodom and Gomorrah. A backward review from time to time, of comprehensive but brief nature, produces good results in the way of evaluating progress and improving the accuracy of foresight, but we must also remember that too constant an eye on the past produces results which are as incurably useless as the pillar of salt in the alkaline desert into which Lot's wife was transmuted because of her backward longings.

Resourceful empiricism in life belongs to the days of the youth of the exact sciences or of education or of a new country with a pioneer population. We have these conditions all as a background for engineering education in America. In our present considerable maturity we must look forward to more rational bases of reflective life and of reasoning, but these must be secured without loss of national or personal originality, initiative and resourcefulness. Time is to-day, yesterday and to-morrow. We have for ourselves only to-day, supported by some memories and records of yesterday and some anticipations for to-morrow. Therefore in our engineering education we must emphasize modes of life and knowledge of natural phenomena as they respectively exist to-day. We should also add thereto competent reflections concerning possible improved modes of future utilization of natural phenomena and probable improved conditions of life resulting from such improved utilization.

Science refuses to be enchained, but will continue with its victorious career of expansion. It is for the engineers to see that these victories are not merely Pyrrhic. For this, our educational processes must touch, elbow to elbow, with the most intellectual expounders of principles that are established in political economy, sociology and finance, in addition to our established association with expounders of the natural sciences.

Early histories deal at length with achievements of tyrants and warriors and but little with mechanical achievements. Such records show the emphasis which was formerly placed on the welfare of the high-born, powerful and wealthy classes and their valuable slaves, to the substantial exclusion of all other orders of humanity. The shifting of this emphasis so as to rest, as it now mostly does in the western world, on community welfare, with the attention comparatively equally directed toward the high placed and the lowly, is one of the most conspicuous revolutions in social relations which has occurred between our days and the days of the ancient civilizations. The classicists are blind and misguided enthusiasts when they unreservedly extol the ancient civilizations. The cruelty and the narrowness of mental interest usually characterizing the powerful coteries in those civilizations is scarcely realizable to minds educated in the broader and more generous spirit of our times, although our times are often derogatively referred to as a mechanical age or civilization.

It is wrong to speak of a "mechanical" civilization, because civilization is intellectual and an intimate correlative or component of the social organization; but we must recognize that true civilization rests upon mechanical development which enables the spread of wealth and comfort to be effected immeasurably more uniformly than characterized the conditions of ancient times, such, for example, as were characteristic of Greece or Rome or Egypt even in the most humane stages of their ancient civilizations. Science and invention can be put to bad uses, but this does not justify engineering education in neglecting the fullest practicable cultivation of the ground from which springs the best character of modern civilization, or in neglecting to examine the characteristics of that civilization itself.

Engineering is a vital and dynamic field of learning which stretches from biology, chemistry, physics and mathematics into political economy, finance and sociology. It is not practicable for any one man to possess complete mastery over the whole field or of any one of its major divisions. We therefore assign particular subdivisions to our individual teachers in the engineering schools, each of these subdivisions being of a scope in which the individual can achieve a mastery. This meets one branch of the teacher's

difficulty, but farther provision is requisite to meet the situation fully. Each particular subdivision closely relates more or less intimately with numerous other subdivisions as well as with its own major division. Each major division relates with each other major division, sometimes with close analogies in the applicable theories, even when the nomenclature and units of measurement superficially appear to have no relations. And all the major divisions and the subdivisions have threads binding them to the natural sciences on one side and to political economy, finance, sociology and psychology on the other side. Moreover, these threads are weighted with various degrees of significance, and this brings us face to face with situations which in some instances may be dealt with with mathematical exactness and in other instances can be dealt with only through examining the balance of evidence (*i.e.*, the balance of the "pros and cons" as commended by the great Franklin).

The problem of securing proper teaching staff for the engineering subjects taught in college therefore has two branches. One of these relates to securing men with the needed learning, ambition, originality and resourcefulness to become and remain masters of their particular growing subjects, who also possess powers of formulation and exposition sufficient to establish scholarly interest in the study of their subjects. The second of the branches relates to selecting from among such men only those who individually have the imagination, ambition and initiative to unremittingly examine and reflect upon the correlations with each other of at least some of the subdivisions of engineering and also upon the specific scientific and economic roots of some particular subdivision or subdivisions.

Any teacher who secures and maintains for himself mastery in a particular subdivision of engineering becomes an investigator on account of the nature of engineering, and such a one is competent for research into the character of scientific principles, their application for the benefit of man, and the propriety of empirical processes which may be utilized where science is not yet established because of the complexity of premises. Such a man is delivered from slavery to predigested textbooks.

It will be observed that the word mastery, as here used, is synonymous with the phrase, Authoritative grasp secured from fullness of knowledge and experience.

The major question to be answered is how such men are to be secured. Various answers have been proposed, but no one of them (in my opinion) is complete. I therefore venture here to give my own, and my doctrine is here spread before you with invitation for criticism and farther test. In science, a theory which fails as a directive for further research within its province, or as a platform from which to improve designs of structures or equipment, is as worthless as the man whose wife called him "Theory" because he so seldom worked. The same is true of a theory in education.

The first tenet associated with my answer holds that experience proves that (in general) the engineering schools as a group must develop the teaching staffs for themselves and not expect to rely on other organizations, such, for example, as industries or schools of education, to develop our units for us; although we should welcome suitable reinforcements from such other organizations. The same conclusion is reached by *a priori* reasoning. This makes intellectual interchange among faculties very important. To secure what we need, each member of our staffs should strive to possess an education arising from experiences that have been secured by contacts with the cross-currents of various creative minds. Part of this should be secured in youthful preliminary education; but part of it ordinarily should be associated with the individual's early period of employment in teaching because the members of staff ought to become established before they are too old, as we need the activity of youthful originality and initiative in the engineering schools.

The second tenet is to avoid undue inbreeding. This requires an interpretation of the word "undue" to make the tenet definite. Different men of experience may ascribe different weights to it. In my opinion, inbreeding exceeding 50 per cent. in staff membership may be undue. As a teaching staff grows in numbers and scholarly scope, it is desirable to seek promising recruits from elsewhere for the purpose of maintaining a flow inward of new experiences; but it is equally needful to maintain a continuous thread of endeavor, which can be most advantageously done by choosing a proportion of recruits from one's own products.

A corollary to the second tenet, therefore, is to select appointees from the product of other colleges as often as from one's own product, and to emphasize the fact that an advantage (especially for the younger staff members) arises from migration. The recognition of the latter condition should prevail over any desire on the part of an appointing officer to hold a staff inviolate from withdrawals. An engineering school has a duty in the preparation of young men for productive endeavor in other such institutions as well as for the industries and for itself. An undue jealousy of withdrawals of competent young men from staffs defeats this duty and also perhaps indicates a lack of fertility in selecting young men and encouraging them to make a high career.

The third tenet (which is closely connected with the foregoing corollary) is to encourage young men

to study and observe in several environments. This may be through formal study elsewhere than at their normal sites of employment or by suitable industrial employment for the period of a few years or by organized study with which is associated industrial employment in vacation periods. Industrial employment in the vacation periods in many instances is equally as serviceable for men of the older and well-established ranks as it is for the younger men. The conferring of fellowships on younger members of staff, available for a year or two of serious study in a chosen academic setting elsewhere, is one of the fruitful expedients which is only too little recognized by engineering schools. Encouraging promising members of the staff to attend, in their individual fields, the summer sessions established for engineering teachers by this society, is a step in the same direction. If salaries and ambitions are right, young men should respond to this encouragement without special financial subvention, because response is farsighted thoughtfulness for personal development.

There is the further corollary that study and travel in European countries (for the American engineering teacher) have the advantage of unfolding widely different environments, and are likely to lead to sound reflection on the part of suitable young men. Individuals who have embraced such an opportunity and who fail to grasp the grounds for differences as well as for likenesses of engineering practise and engineering education on the two continents, along with some recognition of the faults of each, have been tested and found wanting and should thereupon be diverted from the profession of engineering education. As far as the facilities for engineering study themselves are concerned, America now rivals the best of Europe in substantially all branches and excels in many. Under the circumstances, the mature student who wishes to become a recognized influence in engineering education, who fails to uncover and embrace the opportunity to glimpse the ideals, the spirit and the resourcefulness of several great men who are in his chosen field in Europe or America, fails to fully utilize his opportunities for education.

The fourth tenet is to encourage teachers who wish to do summer school teaching to secure such employment in the summer sessions of engineering schools distantly located from the sites of their own winter teaching. It is my opinion that continual teaching on the same premises and among the same colleagues during the academic years and the intervening summer sessions inevitably cramps development. Staleness is likely to result from too continuous an effort of one kind carried on without external fertilization. It would be a step forward for the engineering schools to man every such summer session with a considerable proportion of teachers drawn from other institutions.

Still another means for carrying through to the same fruitful end is for engineering schools to definitely exchange younger staff members for such periods as one or two academic years. Difficulties for the engineering schools themselves arise regarding this on account of family movings, matching of living accommodations, differences of cost of living in different educational centers, differences of salaries in like ranks and other items. This plan therefore is not likely to be frequently used, but all the other plans are practicable of execution, provided the necessary incentive is impressed on the individual teachers. This society could achieve an additional forward step for engineering education if it undertook to procure the establishment of several definite exchange professorships among the American engineering schools, outside of the normal budgets of the schools, which could be conferred from year to year on particularly distinguished professors of such schools who would then lecture for a semester or two at schools other than their own.

The ideas presented herein are not academic platitudes, but are in fact pedagogical sense. They are paths of good business sense for engineering teachers to follow. To those who say that they are exalted but impracticable ideas, the answer is that they are indeed exalted ideas, and engineering education needs such ideas put in practise as useful truths. Moreover, they are of proved practicability. For example, in the large staff of the distinguished department of electrical engineering of which I have the honor and privilege to be the leader, there are few of us who have failed to embrace education and practise in more than one richly serviceable environment. This circumstance has manifestly proved to the advantage of our mutual work.

Engineering education has been endowed with its fair share of great men. We may think of Swain, Van Hise, A. W. Smith, Irving Church, Mansfield Merriman and others of their group. It now possesses a considerable proportion of such men and also of younger men with attributes that will bring them to equal eminence and influence; but President Wickenden in his final report as Director of Investigation for this society expresses a fear that the number of such men is not increasing numerically in proportion with the growth of numbers of engineering schools and numbers of students. The work of each great man is a guide-beacon illuminating the way. But his successors who sit contentedly in the shadow of the beacon without effort to progress, waste opportunity. The doctrines of academic tenure for older men and academic freedom for both older and

younger men are sometimes said to stand in the way of insisting on effective individual and group work. It is true that some individuals are unable to maintain their intellectual balance when partaking of the "strong wine of freedom," but such men are out of place in the teaching staff of an engineering school. It is a strain on the doctrine of academic freedom to retain such men unless age, length of service or laches of the institution appeal for tolerance.

Thinking with accuracy is no child's accomplishment. That accomplishment must be learned first in thinking analytically and then in thinking synthetically. Such education goes much faster when the effort is stimulated by the interest of mastery rather than when only sustained by the urge of duty. Each classroom and laboratory should be a space redolent with curiosity and discussion.

To secure the needed results it is important to utilize foresight and judgment applied through measures such as my answer comprises. All these measures depend upon developing among engineering schools a greater unity of purposefulness designed to result in a larger sentiment among their staffs in favor of migration than is now observable.

Finally, to secure the ends, in my opinion it is necessary for the engineering schools to maintain salaries in the higher levels which are equal to the highest which their universities support. Otherwise the ultimate attractions are insufficient to appeal to the fitting youths. I often hear it suggested that the upper available salary level has only small influence on the ambition of the younger teachers, but I am convinced that this is an erroneous interpretation of the attitude of the most able of our younger men. The opportunities of the life are compellingly attractive to men of suitable ambition, but the opportunities can not be most fully developed unless finally accompanied by a generous situation in support of a professional self-respect that comports with a distinguished reputation for learned mastery in the field.

A sustained effort to accomplish these ends will, I believe, maintain engineering education on an enviable level of achievement among the great educational processes of the nation.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION M (ENGINEERING)

By Commander N. H. HECK

SECRETARY, U. S. COAST AND GEODETIC SURVEY

IN SCIENCE for July 28, 1933, there was a review of the scientific sessions of the American Association for the Advancement of Science and affiliated societies. For several reasons that of Section M and affiliated societies was not included, the chief reason being that it required additional time to prepare a report of the many sessions in such a way that the relation between science and engineering would be emphasized. The meetings of all affiliated engineering societies are discussed, except that the joint meetings of the Econometric Society and several engineering societies have already been described in SCIENCE under Section K (Social and Economic Sciences). Numerous other engineering societies met in Chicago, but this report includes only affiliated societies. The Western Society of Engineers, an associated society, held no session, but played a very important part in arrangements. Owing to the delay in presenting this record of the meeting many of the papers mentioned have already been published in full or in abstract. Information can be obtained in regard to these from the secretaries of the societies concerned.

The second week of the joint meeting of the American Association for the Advancement of Science and affiliated societies at Chicago on pure and applied science during A Century of Progress was devoted to applied science and, since nearly all the engineering societies took part, it was generally known as Engineers' Week, though there were numerous meetings in other fields of applied science. Section M (Engineering) was the connecting link. It held a joint meeting with all the engineering societies and a joint meeting with the American Society for Testing Materials, these being the occasions of addresses by distinguished foreign speakers made available through the association.

At the general meeting on Tuesday night, A. P. M. Fleming, of the Metropolitan Vickers Company, had as his subject "A General Review of the Development of Industry and Engineering During the Century."

Reviewing the past one hundred years of development in industry and engineering, certain considerations are outstanding. First, engineering is the basis on which the magnitude and rate of progress depends. Through the growth and application of scientific knowledge it has made the world a small place; it has increased speed of travel by road, rail, air and water; through speed of communication, it has eliminated time and distance; it has enabled the earth's resources to be made universally available; it has been the means of providing for the growth and maintenance of populations with increasing standards of living. In other directions, medical science

and its universal availability has made enormous strides, not only in the curative aspect of disease but in disease prevention and in improved hygienic standards. Similarly, there has been an extension of the availability of all grades and phases of education.

The wealthiest of the community one hundred years ago had only a fraction of the amenities that every one enjoys today. Hours and arduousness of labor have steadily diminished and provided the leisure for cultural pursuits, physical recreation and amusements.

It is sometimes said that human nature can not control the machines that science and invention have produced, and that this is largely responsible for the present state of world derangement. It is true that, due to the creative impulse of war, facilities for production attained a century's advance within a few years and that exchange and distribution did not keep pace with this abnormal growth, but surely this is a problem of organization only, and should not be beyond human intelligence to solve. There are moreover certain features in the trend of affairs that should give us cause for confidence. The early part of the century—in fact, the greater part of it—saw very rapid development of wealth and its acquisition by comparatively few people. The material progress of the community seemed to matter most. To-day there is a tendency, which the economic stress has served to emphasize, to regard industry as a service, as a means to an end, the end being the greater development of intellectual life and higher ethical standards. It is surely the responsibilities of us, who are engineers, scientists and industrialists, to foster this spirit.

On Wednesday, Engineers' Day, at a colorful ceremony on Soldiers' Field, the Daniel Guggenheim Medal was awarded to Juan de la Cierva for development of the theory and practise of the autogiro. Dr. Cierva arrived by autogiro, landing near the speaker's platform. A. A. Potter, president American Society of Mechanical Engineers, who presided, said that "Progress has always been dependent upon persons with courage and vision to explore the unknown and upon those who made life easier through invention and discovery."

At the Engineers' Dinner, arranged by the Western Society of Engineers, Edward J. Mehren, in his address on "The Contribution of Engineering to Progress," showed that the long road which mankind is traveling has many ravines and chasms, such as greed, oppression, war and many other hindrances. The engineer has helped to bridge these chasms. During the machine age, which is but 3 per cent. of recorded history, there has been too lavish use of the new gifts which it has brought us, but we are learning to master the new instrument. The engineer is not only making new bridges across the chasms, but is providing materials which can be used for higher bridges if those responsible in other fields can use them.

Karl T. Compton, in his address "The Century of Progress—What Next?," after reviewing the progress predicted that research in pure science, engineering and social science will receive greater attention and become more effective. He showed that there is a tremendously important job, largely due to the work of the engineer, for which the engineer will have to take a large share of responsibility. There is reason for optimism.

American Society of Civil Engineers

The American Society of Civil Engineers functions in technical matters through divisions, each relating to a branch of the field. Most of the papers were delivered before sections. There follows a general review with reference to papers where appropriate.

In introducing a symposium on "Can Government Costs be Reduced?" Charles Keller pointed out the lack of need for many proposed new projects. Planned economy requires expenditure of the taxpayers' money for indispensable services only, with consideration of his ability to pay and the preservation of his consuming power. E. P. Goodrich feels that, inasmuch as the government's entry into the field of business will involve increased cost, means should be found to offset this. Frank Bane held that since 80 per cent. of state expenditures go to education, welfare, highways and public health, even if economies can be effected, great reduction will be only at the cost of curtailment of needed services which can be provided most economically by the state. Reorganization of the state was discussed by Luther H. Gulick. He feels that in all matters of broad economic problems the state has failed. It should turn over all such matters to the federal government, through constitutional amendment if necessary, and confine itself to local government. This would make possible a reorganization of local government with many reforms. C. E. Rightor showed the difficulty of curtailing local taxation without loss of essential services.

A Century of Progress in Construction: In discussing "The Construction Engineer—A Centenarian," W. C. Huntington pointed out the important place of engineering works in the developments of the century. The construction engineer has a fascinating task in carrying through his projects in spite of difficulties imposed by man and nature. T. L. Condron, in discussing "The Development of Industrial Building," showed that the outstanding cause of progress was the introduction of iron as a structural element. New construction methods are exemplified in many of the buildings of the Century of Progress. P. E. Sabine showed that sound control is going to be demanded in buildings of the future. Acoustical engineers can solve the problems. O. H. Ammann showed the advancement in bridge construction. The

George Washington Bridge, with eight times the suspended weight, was built in one third the time required for the Brooklyn Bridge. New understanding of stress and new materials point to revolutionary changes in bridge design and construction. Elwood Mead used Boulder Dam as an illustration in discussing "Modern Methods used on Reclamation Projects." Many new and difficult problems have required solution. Lytle Brown, on the subject "National Defense Facilities on Land," showed that the great work of the engineer in war relates to mobility, fortification and shelter. All the problems are on a large scale and structures have to be built with high speed and without specifications and often without proper materials. Resourcefulness and valor are needed. F. C. Ruhloff showed that modern construction machinery has mobility or portability, speed of operation and ease of control. With decrease in manual labor power per man has increased. All visitors to the fair will find interest in V. G. Grove's discussion of the unique problems in the design of the skyway and observation towers.

Transportation: F. C. Jonah discussed "One Hundred Years of Transportation." The pioneers were without transportation in the present day sense since practically all and certainly all rapid transportation belongs to the present century. We have not yet reached the limits of development. J. H. Gardner discussed the development of water transportation during the century. He stressed the present importance of the merchant marine. W. J. Cahill dealt with water terminals. Though ships seem to have reached their maximum size, the terminal problems are numerous and different at every port.

Highways: E. J. Mehren stressed the necessity of selling the idea of improved highways to the public as a background of a proper program and its maintenance. Other papers dealt with methods of making traffic counts and of arriving at the loss through traffic delays.

Basic Surveys for Engineering Works: W. Bowie, in his paper on one hundred years of control surveys, showed that largely as a result of improvement in instruments and methods, the control surveys of the United States have been speeded up without loss of accuracy so that the basic surveys are nearing completion. G. D. Whitmore discussed the many uses of control surveys in cities. M. L. Greeley listed the many difficulties arising from poor character of early land surveys. He stressed the need for better status for land surveyors.

Sewage Disposal Problems: Several engineers of the Great Lakes region outlined the many problems of sewage disposal without detriment to water supply and fish life. Pollution of lake water is a serious problem. A. L. Fales pointed out that even with treatment there is necessity for discharge of effluent in such a way that tidal currents, river flow or other water movements will carry it away. L. F. Warrick pointed out the value of waste utilization as a profitable means of preventing stream pollution. S. A. Greeley discussed the broad subject of "Municipal Facilities for Public Health." There has been urgent need for improved municipal facilities, including water works, sewerage systems and disposal plants. These have been provided and the standard of living increased with little increase in unit cost.

City Planning: H. E. Young dealt with "The Value of Planned City Development." Cooperation of all interests is needed to meet community needs such as boulevards and recreational areas. Sometimes social and sometimes economic view is uppermost. J. H. Miller showed that slum clearance and the elimination of poverty go hand in hand. Low cost housing projects provide the remedy but are hard to bring about. D. H. Sawyer pointed out the new opportunities of the engineer in city planning. He outlined the requirements for projects which should receive consideration at the present time. J. L. Crane, Jr., with the subject, "Planning for Planning," pointed out the need for a national agency to coordinate all the plans to fit into a proper national program of development. No individual or organization can achieve planned guidance, but only the government expressing the popular will.

American Society of Mechanical Engineers

The contribution to Engineers' Week consisted of 44 sessions with 126 papers. The technical sessions were well attended and the discussion was lively and profitable. Several interesting conclusions can be drawn from a review of the papers on the program. The demand upon mechanical engineering is for greater refinement and higher accuracy in design and development. The engineer, therefore, must use the latest applications of knowledge in the basic field of mathematics, physics and chemistry. Ample evidence appeared of a broader and deeper use of engineering and scientific principles than was brought out at similar meetings forty years ago. There is obvious need for closer cooperation between the workers in pure and applied science.

The following is necessarily a brief abstract covering some of the papers which present research results:

Aeronautics: Seventeen papers dealt with nearly every phase of design, operation and test. Th. Von Karman and C. B. Millikan discussed "The Use of the Wind Tunnel in Aircraft Design Problems." The paper dealt with the extrapolation of wind tunnel results to full scale and with actual solution of many problems of design. C. Witoszynski, of Poland, con-

tributed a paper on "Wing Profiles with a Given Initial Moment." C. Wiesel Levy, of Germany, gave other results of a theoretical and experimental investigation of the influence of the fuselage on the wing. A. Klemin's paper on "The Spin" gives rules for spin design.

Applied Mechanics: Only a few of the many subjects discussed can be mentioned. R. Bernhard, of Germany, discussed a theory of vibration of bridges and a means of measuring them. Graphostatics was interpreted by H. M. Westergaard as statics in which geometry plays a part. He outlined its uses. "Amplitude of Non-harmonic Vibrations" was considered by J. P. DenHartog. New experiments on wind force and wind pressure on buildings were presented by O. Flachsbart, of Germany. He recommends the use of models of buildings and aerodynamic testing to determine stress. D. H. Young presented a rational equation for the design of steel columns to replace the present empirical formulas. S. Timoshenko proposed a new method for proportioning plate girders. The influence of rate of shear on shearing stress was discussed by Jas. Jamieson on the basis of experimental results. A new test method of determination of inherent stress was described by Josef Mather, of Germany.

Mechanical Springs: R. F. Vogt, in his paper on "Stresses in Helical Springs," developed a combined formula suitable for practical purposes for determining the maximum torsional and bending stresses in helical springs. Other papers dealt with the effect of corrosion pits on fatigue and fatigue tests of springs.

Fuels: "Smoke Abatement" was the chief subject under discussion. The subjects included grindability, the effect of preheated air on underfed combustion and measurement of cinders and fly ash. H. F. Johnstone discussed the removal of sulfur compounds from waste gases. The human side of smoke abatement was considered. There was also a paper on "Fuel Technology and the Human Side of Smoke Abatement."

Process Industries: The subjects discussed included grindability, the industrial dust problem and the deairing of clays during processing. Mechanical methods in the treatment of sewage and garbage disposal were also discussed.

Steam Power: A thermal study of the available steam turbine cycles was presented in convenient form for use by G. A. Hendrickson and S. T. Veselowsky. Other papers dealt with the prevention of calcium sulphate scale and the problems presented by the precipitation of moisture in the low pressure region of condensing turbines.

Hydraulics: There was a symposium on water hammer, the first comprehensive treatment of this subject in the English language. Theories and methods of dealing with the problem were discussed. The existing situation was clarified and the way pointed to further needed research.

Another symposium dealt with boiler feed water. There were presented the results of experimental work in measuring the priming of boilers, a method of determining the sulphate ion in boiler water, and the problem of the determination of dissolved oxygen in feed water.

Metal Cutting—X-Ray—Cast Iron: Investigations in the problems of cutting metals were presented. Testing by a single point cutting tool, results of investigations on cemented carbide cutting tools and the removal of a metal chip with a cutting tool were discussed. In presenting the last-named subject, Frederick Schwerd, of Germany, described the use of photographs with a light exposure of one millionth of a second. H. R. Isenburger outlined the need for an effective x-ray machine for field inspection of welded joints. Newly discovered properties of cast iron for machine construction were also discussed.

Railway Research: A symposium on research in railway engineering was presented with the following conclusions: First, criticisms directed against the railroads for lack of technological progress have little basis of fact. Second, there exists a spirit of cooperative understanding between the railroads and industry. Third, there are the following general tendencies in railroad development: Cars of lighter weight and greater strength; development of standard equipment interchangeable with maximum ease and maintained at minimum expense; use and development of materials to produce lighter, better and more economical equipment with greater capacity or power per unit of weight leading to simplification of design and reduction of number of parts; development of boilers for higher pressures; development of valve gears; development of locomotives to reflect the best power plant experience and development of materials and practises to reduce wear and tear on rails and structures and reduce operating expenses.

Printing Research: In addition to a number of papers reflecting mechanical developments in the printing industry, two papers of importance to research were presented. H. D. Hubbard gave an analysis of printing research dealing with legibility of printing, type, design, printing papers, ink and color. A. C. Jewett presented a program of cooperative printing research in America and projected an agency to conduct it.

American Institute of Electrical Engineers

The American Institute of Electrical Engineers had a well-rounded program, covering six technical sessions where heavy attendance and lively discussion

attested to the timeliness and general interest value of the subject-matter.

The Lamme gold medal was awarded to Past President Edward Weston, originator of the Weston Electrical Instrument Corporation. This award was established for the encouragement and recognition of meritorious achievements in the development of electrical apparatus or machinery.

The address of President H. P. Charlesworth had as its topic "The Engineer and A Century of Progress." Emphasizing the effects of science and engineering upon the life of man and the basic need for a better understanding of these effects on human society, he urged engineers to take a greater part in all affairs affecting human welfare.

One session was devoted to protective devices which are essential to high voltage transmission. E. E. George described the various methods that have been developed for testing high speed distance relays. H. P. Sleeper gave from the operating engineer's view-point the practical and theoretical problems involved in applying relays for the protection of high voltage, open wire, interconnected transmission lines. He outlined the requirements for satisfactory relay protection. R. M. Spurck and W. F. Skeats discussed the factors involved in the heavy duty laboratory testing of circuit breaker equipment. They showed that while conditions at laboratories do not permit the testing of larger capacity breakers at the desired conditions, extrapolation from tests can be accepted with confidence. R. C. Van Sickle and W. E. Berkey discussed "Arc Extinction Phenomena in High Voltage Circuit Breakers Studied with a Cathode Ray Oscillograph" and showed how records, obtained with a rotating film operated in a vacuum, give the full story of the arc, subsequent reignition and final extinction. D. C. Prince described a compression type low voltage air circuit breaker, which has been developed to replace the fuse for slow voltage circuits in ordinary use. A subcommittee report on recently developed high voltage lightning arresters showed that they are more effective than the earlier types. The investigation emphasizes the need for information regarding the dielectric strength of equipment made and tested under different conditions and standards in different plants and laboratories.

Session on Electrical Instruments and Measurements: R. W. Carson discussed "Better Instrument Springs." He described new methods of precision testing and measuring of instrument springs and apparently effective methods of artificially aging them. He discussed the methods of treatment both of spring material and of springs. A portable oscillograph with unique features, described by K. A. Oplinger, utilizes several new optical and electrical features. The optical system permits simultaneous viewing and photography of transient electrical phenomena. Other features add to ruggedness and convenience.

Electric Power Transmission: Several papers dealt with methods of minimizing line trip-out due to lightning to avoid system disturbance. Research in new fields relating to electric power cable and their associated dielectrics. These dealt with the life of different kinds of dielectrics; the artificial aging to secure in a few weeks deterioration which ordinarily requires a year, thus making it possible to design better cables; and the effect of high oil pressure on electrical strength of cable insulation, with the conclusion that high pressure adds to endurance strength for long time application of voltage but not for impulses.

Communication and Electric Power Generation: A paper entitled "Carrier in Cable," by A. B. Clark and B. W. Kendall, gave the results of an interesting experiment with a 25 mile loop of underground telephone cable. By interconnecting the 68 pairs of conductors in this relatively short cable telephone circuits 850 miles long were provided, with the result that quality of transmission and methods to prevent interference between them were satisfactory. This advances the horizon of economical commercial communication and promises a high grade of flexibility in telephone plants.

"Precision Timing of Athletic and Other Sporting Events" was discussed by C. H. Fetter and H. M. Stoller. They described a high-speed motion picture device which permits the simultaneous photography of the events to be timed and the dials of a special clock. Accuracy of .01 second with estimation to .002 seconds is possible.

Electrophysics and Related Subjects: A new idea in room heating was presented in a paper by L. W. Schad on "Obtaining Comfort Conditions by Controlled Radiation from Electrically Heated Walls." By heating the walls, the temperature can be kept very uniform at a point which prevents body radiation. He stated that the power requirements could be worked out on an economical basis.

American Institute of Mining and Metallurgical Engineers

The American Institute of Mining and Metallurgical Engineers, in aiming at a well-balanced program between technology, entertainment and opportunity to see the Century of Progress, curtailed the number of technical papers as compared to some other societies.

Special attention was given to the non-metallic minerals (excluding fuels). C. C. Whittier, in a review of "A Century of Progress in Non-metallics," showed that these are key elements in many of the major industrial processes and products. Applica-

tion of new materials is likely to result in substantial changes in types of construction.

M. M. Leighton described the research program of the Illinois State Geological Survey. The survey is organized to bring to the problems of non-metallic research the combined value of all lines of scientific study—geological, physical, chemical and microscopical—and by this means to bring about the most complete knowledge of mineral substances and of new and improved uses for them.

Walter H. Weed discussed the present concepts of formation of non-metallic deposits. Theoron Wasson described the various geologic settings where oil may occur and showed how geophysical methods may be used in detecting them. He considers this one of the great accomplishments of the past century. C. H. Cady described the microscopic study of coal of the kind found in Illinois. In discussion M. M. Leighton brought out the important possibility of the future of pulverization and mixing of coals to provide uniformity and to meet special needs.

American Society for Testing Materials

Outstanding among the important technical contributions presented during the thirty-sixth annual meeting of the American Society for Testing Materials was the Edgar Marburg Lecture on "Crystalline Structure in Relation to Failure of Metals, Especially by Fatigue," delivered by Herbert J. Gough, National Physical Laboratory, England. Dr. Gough was one of the guests from abroad on the joint invitation of the association and the Century of Progress, and the lecture session was a joint one of the American Society for Testing Materials and the American Association for the Advancement of Science. The speaker pointed out how modern knowledge of the atom has changed our views of the cohesion and strength of materials, especially of metals. A piece of metal is made up of millions of tiny crystalline grains; each grain in turn is made up of a regular geometrical arrangement of millions of atoms. The pattern of arrangement of these atoms in each grain is just alike, but the direction of the lines and planes of the pattern is different for each grain.

Dr. Gough for some ten years has been studying the strength of specimens of metal so prepared that each specimen consists of a single large grain. He has found that as the specimen is repeatedly loaded the crystal breaks up into a large number of little "crystallites," and he thinks that the paths of the electrons or the atoms around the nuclei may be affected. The first effect of this action is to actually strengthen the material, but if it goes on long enough, in the process of break-up of crystals, atoms at critical points seem to get actually torn apart, and if this process continues a spreading crack results. This, he thinks, is the beginning of the sudden, disastrous failure, popularly known as "fatigue of metals."

Dr. Gough's lecture was illustrated by many photomicrographs of metals which had been subjected to stress, and the lecture constitutes a very important fundamental summary of our present-day knowledge of the nature of solid bodies. This is a field in which very little work has been done, the atomic physicists having confined their attention almost exclusively to gases. The entire lecture is being printed in pamphlet form and will be available from the society.

In addition to the thirteen sessions of the meeting of the American Society for Testing Materials, at which the formal technical papers and committee reports were presented, there was a round-table discussion on spectrographic analysis and an open meeting of the committee on interpretation and presentation of data.

The program contained 49 reports of committees and 33 technical papers. The committee reports covered their respective activities and gave the various recommendations covering the standardization work under their jurisdiction. The society's second important function of promoting the knowledge of engineering materials was emphasized through the many technical papers which reported the results of extensive research work on properties and tests of materials. This phase of the work is of great importance, for progress in many lines depends upon the efficient and proper use of materials. Of the items the symposium on cast iron and the report on "Significance of Tests of Concrete and Concrete Aggregates" were preeminent.

The cast iron symposium, jointly sponsored by the American Foundrymen's Association and the society, adds much to metallurgical literature. While it is primarily a compilation of information from scattered publications it is a critical compilation, correlation and interpretation by experts and, in addition, contains much hitherto unpublished data. The sections cover physical properties, classifications and specifications, design and effect on physical properties, machineability and wear, corrosion, heat treatment, welding, etc.

The report on the "Significance of Tests of Concrete and Concrete Aggregates" gives an effective summation of the significance, limitations and applicability of the more widely used tests, including a discussion of their importance and other pertinent facts.

In the ferrous metals field, several interesting papers were given. Studies on a modification of the Rohn test for creep of metals were described by C. R. Austin and J. R. Gier. This test offers possibilities as a rapid means of classifying alloys according to

their metallurgical behavior and utility for service at high temperatures.

A paper on impact testing in torsion described this method for determining impact resistance of hard materials, such as hardened tool steel. The method has already been instrumental in obtaining a better understanding of the treatment of hard metals and promises to give reliable data not always forthcoming by the impact methods which are used at present.

An "overnight" accelerated fatigue test was described by H. F. Moore and H. B. Wishart, of the University of Illinois. Because the "short-time" tests which have been developed up to the present are reported as giving unreliable data, the possibilities of this "overnight" test are most interesting. Five or six specimens of a known Rockwell hardness are subjected to about 1,400,000 cycles of stress taking about 15½ hours in a rotating-beam fatigue machine. The ultimate tensile strengths of the specimens are then determined and, after making corrections proportional to the hardness, the stress applied for the period of the cycles is plotted vertically against the tensile strengths—horizontally. The value of the endurance limit is obtained by reading the figure on the applied stress ordinate opposite that point of the curve which is a maximum for the tensile strength. This method checked well for various metals when compared with long-time test results. The theory of the test is that below the endurance limit repeated flexure increases the strength by cold work, while above the endurance limit cracks develop which reduce the tensile strength.

A strong non-ferrous metals program marked the meeting. H. B. Gardner and C. M. Saeger, Jr., discussing "The Effect of Sulfur and Iron on the Physical Properties of Cast Red Brass," showed that casting at a high temperature showed greater influence on lowering the physical properties of this brass composition than the addition of sulfur. Iron, when added, improved all the physical properties, with the exception of electrical resistivity. A paper by C. E. Swartz and A. J. Phillips compared certain tin-base and cadmium-base bearing alloys, pointing out that the cadmium-base showed equal or better properties than the tin babbit. Motor tests showed that the cadmium-base alloys continued to function after the tin-base metals had failed, due to temperature. In discussion Dr. Gillett mentioned that, since tin is controlled abroad and fluctuates widely in price, domestic cadmium may compete with foreign tin for bearing metals, even where the ability to stand up at high temperatures is not required.

The committee on corrosion of non-ferrous metals and alloys presented the results of the first year's exposure of the twenty-four metals and alloys which are included in its extensive atmospheric corrosion tests at nine locations in this country. Extensive tables show the changes in tensile strength and elongation, the change in weight and describe the corrosion films formed on the specimens.

According to E. H. Dix, Jr., who presented a paper on "Corrosion Resistance of Structural Aluminum," beam and column tests performed on full-size sections show no decrease in the load-supporting capacity after exposure to severely corrosive conditions which caused marked losses in the mechanical properties of thin-sheet specimens of the same alloy.

The paper on "The Fatigue Properties of Light Metals and Alloys," by R. L. Templin, gave a considerable amount of fatigue data for nearly all the commercial light alloys of aluminum and for several magnesium-base alloys. In order to define the endurance limits of these light alloys, Templin pointed out, the number of cycles of stress required is of the order of 500 million, as shown by comparison with foreign laboratory tests which give much higher endurance limits based upon tests of a much smaller number of cycles.

At the cement and concrete sessions, P. H. Bates, in his paper on "Status of Specifications for Hydraulic Cements in the United States," presented some very interesting conclusions. He points out that present-day engineers have learned enough about cement to know that any one type will not meet all requirements. He advocates the use of six or seven special cements.

A hypothesis on the permeability of brick masonry walls was presented by W. C. Voss. His more than two years of investigation indicated that a brick, to produce the best results, should absorb from 5 to 10 per cent. of its weight in water in two days and it should absorb this at a low rate after the first 10 or 15 minutes. Professor Voss believes that cement and lime are equally important constituents of a good mortar and neither may be omitted where all the usual conditions of exposure and construction exist.

From the standpoint of industry the paramount significance of the annual meeting of the American Society for Testing Materials was the action taken in developments and changes in many specifications and test methods. Of the new standards approved for publication as tentative, 26 are specifications for widely used material and ten cover methods of test. Of the 228 tentative standards which the society has issued, 60 were recommended at the sessions to be adopted as standard and revisions in many standards were approved.

This great volume of standardization work is some indication of the intense activity of society committees during the past year. There has been no diminution in this important work despite losses in society income and membership.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

This was the fortieth anniversary meeting of the Society for the Promotion of Engineering Education. Numerous conferences were held on a wide range of subjects including: The teaching of English, drawing and mechanics; coordinated engineering courses; cooperative engineering education, a subject particularly difficult on account of disturbed economic conditions; and industrial engineering. Various problems relating to the different engineering courses and to advanced education were discussed.

The presidential address of R. A. Seaton was on "The Future of Engineering Schools on the Economic Life of the Country."

At the annual dinner, Dexter S. Kimball spoke on "The Personalities of Engineering Educators." He stressed personality as of more importance than the subjects taught. A great teacher is one who has a scholarship, power of expression, and particularly the power to illustrate, power to inspire, fairness to student, humor, appearance and character. One of the finest things that can come to any man is to be taken into one of the great university communities. It ought to be difficult for him to get in and just as difficult to get out.

The Lamme Medal was awarded to Dexter S. Kimball. This is given each year to the chosen technical teacher for accomplishment in technical teaching or actual advancement of the art of technical training.

President-elect W. E. Wickenden, in expressing appreciation of the honor conferred on him, mentioned the esteem in which the organization is held and the widening circle of recognition of its active service, not only to the field of engineering education, but to the entire field of higher education. Engineering education no longer needs defense, and it should be commended to our associates.

SCIENTIFIC EVENTS

BOTANY AT THE UNIVERSITY OF OXFORD

ACCORDING to the London *Times*, the increasing numbers of students of botany has made necessary the extension of the buildings of the department of botany of the University of Oxford, which flank Inigo Jones's gateway to the Botanic Gardens opposite Magdalen. The alterations, undertaken with a special university grant of £2,000, were completed by the beginning of the term.

Botanical studies at Oxford are taking on a greater importance with the growth of exploration and research in Africa and in other regions. There are now twenty candidates in the final school of botany. In addition to these the department receives a much greater number of elementary students, for whom the study of botany forms only a part of their work. Their number has grown since the recent establishment of the Honor School of Geography, whose students are required to take an elementary course in botany.

On the other hand, the supply of students from the department of rural economy has ceased, for since the reduction of the government grant in the interests of economy, C. S. Orwin and his lieutenants in Parks Road have had to suspend for a time the teaching—though not the research—side of the department's work. Despite the stoppage of the supply from this source, the botany department last term had the record total of 130 students on its books, including post-graduate research workers. Of the latter, one is a professor of botany recently expelled from Germany because of his Jewish blood.

The main feature of the extension is the addition of an upper story to the west wing of the building. This is for the use of students of mycology, the study of fungi and plant diseases and includes a sterilizing room, a room for demonstrations and a small chamber for inoculation. Above these rooms a flat roof has been constructed for students doing physiological experiments which require an absence of shade.

The new work has been carried out entirely on the existing building and does not encroach at any point on the 300-year-old Physic Garden, the oldest of its kind in England, which, with its symmetrical paths and flower-beds, statues and fountains, remains Oxford's only example of the ideal garden of Stuart times.

SCHOOL FOREST FOR THE UNIVERSITY OF CALIFORNIA

TWENTY-SIX hundred acres of forest land in El Dorado County have been given to the University of California as a school forest for the division of forestry in the College of Agriculture by the Michigan-California Lumber Company. The property will be operated for the benefit of the lumber industry.

The president of the Michigan-California Lumber Company, John W. Blodgett, of Grand Rapids, Michigan, in presenting the gift to the university, said: "We desire to offer to the University of California the title to about 2,600 acres of our land to be managed under forestry principles by the division of forestry of the university."

The University of California offers complete training in professional forestry. At the present time there are approximately 125 undergraduate students

and a group of graduate students. Heretofore, the division has lacked a forest of its own, such as those possessed by other forestry schools.

The tract now acquired is near Placerville on the Georgetown Divide, not far from Coloma, where John Marshall discovered gold in California. Two county roads run through the property and it is well situated, both as regards accessibility and ground conditions for future logging operations. Most of the tract is well covered with excellent second-growth which the company has been protecting for many years. The first-class soil and climate give growing conditions of the best.

Three fire lookout stations of the United States Forest Service are close to the tract; one of them overlooks the entire area. The fire hazard is at a minimum, according to Professor Walter Mulford, head of the division, and the State Division of Forestry has agreed to provide fire protection for the tract without expense to the university. As the land is within the boundaries of the El Dorado National Forest, the actual work of protection will be done by the El Dorado National Forest, and the State Division of Forestry will pay the Federal Forest Service for this protection.

With one exception, this is the largest school forest to be owned by any educational institution in the United States; Yale alone has a larger one, in Connecticut. The Harvard forest is of 2,100 acres, that of Cornell 1,800 acres, New York State College of Forestry 2,200 acres, University of Washington 2,000 acres.

CONFERENCE ON QUANTITATIVE BIOLOGY AT COLD SPRING HARBOR

As reported in SCIENCE, June 2, plans were made to hold symposia at the Cold Spring Harbor Biological Laboratory this summer. These summer conferences, as inaugurated there, are an experiment in scientific procedure. Participants have found the symposia of this, the first summer, to have been of such value as to indicate that this procedure can contribute to advance in biology. The essential characteristics are as follows: A small group of investigators, actively working upon a given aspect of modern research, representing mathematics, physics and chemistry as well as biology, are brought together at the laboratory for work and conference of at least a month's duration; symposia are given from time to time, in which those in residence, and others invited for the purpose, take part. Much importance is placed upon the extent and type of discussion following the formal presentation of papers, and everything is arranged with a view to fostering valuable discussion: speakers are requested to emphasize theoretical and controversial aspects, ample time is given for discussion, the number of persons attending the symposia is kept small, and only those actively interested in the subject are invited. Problems are discussed from the point of view of men working in the basic sciences as well as from that of those working in biology. The comparatively long duration of the conference-symposia is of great value for many reasons, of which one example follows. Opportunity for revision is afforded between the presentation of the formal papers and their collection for publication. The discussions are taken down stenographically, and are subsequently rewritten by the author of the paper, in consultation with the active participants in the discussion. The revised discussion is resubmitted to the resident group for final consideration. The paper and discussion, as finally published, consequently represent the best considered thought of the group on the subject.

Having seen the method in operation this summer, it is believed that it admirably helps to meet an important need in biology. Modern quantitative biology is so young, and biology in general has become so specialized, that it is very desirable that productive men should have adequate opportunity to expose their work and ideas to the appreciative criticism of the relatively few men in the country who really know what a given investigator is doing and why he is doing it. Furthermore, the basic sciences are not of as great value to biology as they should be, partly because few investigators in mathematics, physics and chemistry sufficiently acquainted with biological problems are actively interested in conducting experiments, or in formulating theories in terms which would be of immediate significance primarily to biologists. It is hoped that eventually, by means of the method, a closer relationship between biology and the basic sciences, and a body of physicists and chemists actively interested in biological problems, will be built up.

The immediate value of conference-symposia, as conducted at Cold Spring Harbor, is obviously greatest to those taking part. At the same time, since large attendance would interfere with the unique advantages of these symposia, arrangements have been made to make the papers and discussions available, with the least possible delay, to biologists at large. As a first step in accomplishing this, *The Collecting Net*, published at Woods Hole, is printing papers and edited discussions as they become available. Over half the papers and discussions have already appeared. In addition to this partial publication in *The Collecting Net*, all the lectures and discussions are to be gathered into Volume I of the Cold Spring Harbor Symposia in Quantitative Biology. Volume I is concerned chiefly with electrokinetic, bioelectric,

coagulation, osmotic and electrochemical phenomena. It is expected that this book will be available for distribution by the end of October. The men taking part in the symposia this summer were the following: Hans Müller, D. R. Briggs, Kenneth S. Cole, Harold Abramson, Stuart Mudd, Hugo Fricke, W. J. V. Osterhout, Herbert S. Gasser, Eric Ponder, D. D. Van Slyke, D. A. MacInnes, Barnett Cohen, Robert Chambers and L. Michaelis.—*A Correspondent.*

THE INCOMING AND RETIRING CHIEFS OF THE BUREAU OF ENTOMOLOGY

Lee A. Strong has been appointed by President Roosevelt to be chief of the Bureau of Entomology, U. S. Department of Agriculture, succeeding Dr. C. L. Marlatt, who retired on September 30.

Mr. Strong's career in the Department of Agriculture has been in the Plant Quarantine and Control Administration, an office distinct from the Bureau of Entomology, but working with it in preventing the spread of plant pests and diseases in this country and endeavoring to bar the introduction of new ones from abroad. He has been chief of this administration since 1929.

Dr. Charles L. Marlatt, who reached his seventieth birthday on September 26, retired on September 30. Before coming to the department, in 1889, he was assistant professor of entomology and horticulture at the Kansas State Agricultural College.

Dr. Marlatt became associated with the administrative work of the bureau and served as assistant chief from 1894 to 1927. During that period he made important contributions to the information on the life-history, habits and methods of controlling important plant pests, particularly the forms that attack fruit trees and cereal and forage crops, and stored-product and household insect pests. He also conducted technical studies on the classification of insects.

Dr. Marlatt is probably best known for his work which led to the passage of the Plant Quarantine Act of 1912, designed to stop the stream of plant pests that had been coming into the United States without restriction from colonial times and had become one of the worst of our crop hazards. When he became chief of the bureau in 1927, he reorganized, under the authority of the Secretary of Agriculture, the plant quarantine work, bringing the sections which had been distributed in the Bureau of Entomology and the Bureau of Plant Industry under a new organization, now designated the Bureau of Plant Quarantine. For a brief period he served as chief of this bureau, as well as chief of the Bureau of Entomology. He relinquished the former position in December, 1929.

MARCHESE MARCONI AT CHICAGO

Marchese Guglielmo Marconi, inventor of radio, arrived in New York City on the Italian liner *Conti di Savoia,* September 28, en route to the Century of Progress Exposition in Chicago, where "Marconi Day" was observed on October 2, in recognition of his contributions to modern scientific progress.

As the first event of "Marconi Day," Marchese Marconi was escorted to the Stadium to attend the official opening of the American Legion Convention, where he spoke briefly on behalf of the Italian Government.

A luncheon at the Museum of Science and Industry, with prominent scientists as speakers, was followed by an inspection of the museum's scientific collection. The Marconi party was received by officials of the fair with a guard of honor and escorted to the Hall of Science. In the court of the Hall of Science a ceremony was held in tribute to Marchese Marconi. Greetings were extended by Rufus Dawes, president of the Century of Progress Exposition, and Governor Horner of Illinois. Dr. Arthur H. Compton, of the University of Chicago, made an address in recognition of Marchese Marconi's achievements in science, and Judge John W. Van Allen, representing the Radio Manufacturers' Association, presented a testimonial.

The lights at the fair were turned on by a radio impulse started in Italy when the planet Saturn came into the field of a telescope in the Florence Observatory. A dramatic contrast in the scientific possibilities since Galileo first studied this planet in his newly perfected telescope was seen in the flashing of the radio beam from Italy to the center of America. Dr. Philip Fox, director of the Adler Planetarium in Chicago, spoke briefly in introduction of the demonstration and Marchese Marconi manipulated the switches that started it. The reception in the court of the Hall of Science was broadcast by the National Broadcasting Company in the United States and Italy.

After the ceremony Dr. Walter Dill Scott, president of Northwestern University, conferred an honorary degree on Marchese Marconi. During this ceremony the crowd in the court of the Hall of Science was entertained by the Bernadini Chorus. Marchese Marconi returned to the rostrum in the court at 7 o'clock to receive radio greetings from the nation.

In the evening of "Marconi Day" the Marchese Marconi attended a dinner of the American Legion and the following day was present at the Legion parade.

The Dante Alighieri Society was host at a luncheon on October 3 in the Illinois Host Building, after which the party was taken through the Hall of Science to view the display of Marconi apparatus there. A reception was given in his honor at the Italian Pavilion when this tour was completed and brief speeches were broadcast on short wave to Italy. A dinner in the evening of October 3 in the Administration Building of the Exposition concluded the formal program.

THE SCIENCE ADVISORY BOARD

THE Science Advisory Board, appointed by President Roosevelt in executive order No. 6238, signed on July 31, 1933, met in a four-day session last week, following its first session a month ago. In the meantime, six committees of experts appointed by the board have been actively at work on questions referred to it by governmental agencies.

Three general types of problems are under consideration. The first are questions of proper organization, or functioning, or program of the scientific and technical services of the government on which the advice of the board has been specifically requested. The second are similar matters which have otherwise come before the board, and which need attention in order that essential technical services shall not be impaired by economy, or unwise projects be supported, as may easily happen when the determining issues are obscure or highly technical. The third are basic considerations of the more permanent policy of the government toward scientific work.

In this latter category we find that the government definitely must operate certain technical services. It seems advisable that it should leave others entirely to private enterprise, while there is a rapidly increasing third class of services where the public welfare and future prosperity of the country will depend very much on the successful development of some method of cooperative attack by governmental and private agencies, so as temporarily to marshal the best scientific talent of the country for their solution, as the problems arise.

The important aspect of the board's deliberations relates to the impossibility of any effective attack on the great technical problems facing the government by any one group of experts alone, be it scientific, economic, social or business. The Science Advisory Board is therefore establishing interlocking contacts with these other phases of the governmental advisory services. Every problem is being considered from all these points of view, in order that the recommendation may be thorough and well considered, and backed by all the groups of qualified experts.

Inasmuch as the actual problems now under consideration are pressing and of a confidential nature, no discussion of them would be appropriate at this time.

The Science Advisory Board consists of:

Karl T. Compton, *chairman*, president, Massachusetts Institute of Technology, Cambridge, Massachusetts.

W. W. Campbell, president, National Academy of Sciences, Washington, D. C.

Isaiah Bowman, *vice-chairman and director;* chairman, National Research Council; director, American Geographical Society, New York City.

Gano Dunn, president, J. G. White Engineering Corporation, New York City.

Frank B. Jewett, vice-president, American Telephone and Telegraph Company; president, Bell Telephone Laboratories, New York City.

Charles F. Kettering, vice-president, General Motors Corporation; president, General Motors Research Corporation, Detroit, Michigan.

C. K. Leith, professor of geology, University of Wisconsin, Madison, Wisconsin.

John C. Merriam, president, Carnegie Institution of Washington, Washington, D. C.

R. A. Millikan, director, Norman Bridge Laboratory of Physics, and chairman of the executive council, California Institute of Technology, Pasadena, California.

KARL T. COMPTON,
Chairman

SCIENTIFIC NOTES AND NEWS

As voted at the Chicago meeting, the Executive Committee of the American Association for the Advancement of Science will convene at the Cosmos Club in Washington, D. C., Saturday afternoon, October 14, at 5 o'clock, to be followed by morning and afternoon sessions on October 15. Special orders of business include: (1) Status of scientific research in federal bureaus. (2) The desirability of selecting from the membership a group to be designated as research fellows. (3) Maintenance and extension of membership. (4) Methods of securing nominations for general and sectional officers of the association. (5) The arrangements for the Boston meeting. (6) Reports of officers and committees. Members of the association having business to present to the committee should communicate with the permanent secretary, Dr. Henry B. Ward, The Smithsonian Institution Building, Washington, D. C.

ON the occasion of the Chicago meeting of the American Chemical Society, a dinner was given in honor of Professor Julius Stieglitz, who has retired as administrative head of the department of chemistry at the University of Chicago. Professor Stieglitz has been connected with the university since 1892, when he was appointed docent in chemistry. Professor H. I. Schlesinger, of the University of Chicago, presided at the dinner. The speakers, in addition to Professor Stieglitz, included Professor William McPherson, a past president of the society, professor of chemistry and dean of Ohio State University; Dr. F. B. Dains, professor of chemistry at the University of Kansas; John Matthews Manly, head of the department of En-

glish at the University of Chicago; Carl Miner, director of the Miner Laboratories, Chicago; Ethel Terry McCoy, research associate in chemistry at the University of Chicago, and Edward Stieglitz, a son of Professor Stieglitz.

Dr. William R. Hainsworth, of New York, was presented on September 28 with the annual Charles A. Munroe Award for "the most outstanding contribution by an individual to the advancement of the gas industry," before delegates to the American Gas Association convention, which met in Chicago. Mr. Munroe, the donor of the award, presented it personally to Dr. Hainsworth, who is director of research at the Electrolux Refrigerator Laboratories at Evansville, Indiana. Dr. Hainsworth conducted the research which developed the new air-cooled type of gas refrigerator.

M. E. Chatton has been elected correspondent of the Paris Academy of Sciences in the section for anatomy and zoology.

Dr. Hugh P. Baker, formerly dean of the New York State College of Forestry at Syracuse, will be formally installed as president of the Massachusetts State College on October 6. He succeeded last February Dr. Roscoe W. Thatcher, who retired on account of ill health and who is now research professor of agricultural chemistry in the college. Governor Joseph B. Ely officiated at the induction, Frank P. Graves, commissioner of education of the state of New York, represented the official delegates, and Dr. Payson Smith, commissioner of education for Massachusetts, represented the state.

Dr. C. E. Grunsky, consulting engineer of San Francisco, has been appointed acting director of the California Academy of Sciences, to fill the vacancy caused by the death of Dr. Barton W. Evermann.

Clinton G. Abbott has resigned as director of the San Diego Museum to devote his whole time to the Natural History Museum. Malcolm J. Rogers, curator of anthropology, has been appointed acting director of the San Diego Museum.

Elbridge C. Jacobs, professor of geology and mineralogy in the University of Vermont, has been appointed Vermont state geologist to succeed the late Dr. George Henry Perkins.

Dr. James G. McAlpine, of the U. S. Public Health Service, has been appointed director of laboratories of the Alabama State Department of Health, to succeed the late Dr. Leon C. Havens.

The Secretary of State for Scotland has appointed John Jeffrey, who has been secretary to the Department of Health for Scotland from 1929, to the office of permanent under-secretary of state for Scotland, which became vacant on October 1 by the retirement of Sir John Lamb. Mr. J. E. Highton, chief insurance inspector in the Department of Health for Scotland, has been appointed to succeed Mr. Jeffrey as secretary to the department.

The Rev. Dr. E. O. James, vicar of St. Thomas the Martyr, Oxford, and tutor and lecturer in anthropology at Cambridge, has been appointed by the Court of the University of Leeds as the first professor to occupy the new chair of the philosophy and history of religion, founded and endowed by a bequest of £25,000 by the late Mrs. Fawcett.

Dr. Frank Clare Wilkinson, at present professor of dental science in the University of Melbourne, has accepted an invitation to the chair of dental surgery and the directorship of the Dental Hospital of the University of Manchester.

V. R. Hardy has joined the research staff at the experiment station of E. I. du Pont de Nemours and Company, Incorporated, Wilmington, Delaware. Previously he had been special research assistant in chemistry at the University of Illinois.

Sydney Steele, who has been working for some time as Commonwealth Fund fellow at the Johns Hopkins University, has returned to England to take up a position as research engineer with Imperial Chemical Industries, Ltd.

Norman Powell, psychologist at the classification clinic, Sing Sing Prison, has withdrawn from the editorship of *The Psychological Exchange*.

Henry V. Hubbard, Norton professor of regional planning at Harvard University, has become a member of the staff of the Tennessee Valley Authority.

Dr. A. G. Black, head of the department of agricultural economics at the Iowa State College, was recently granted leave of absence to become acting corn-hog production chief of the Agricultural Adjustment Administration of the U. S. Department of Agriculture. He will assist in the formulation of initial policies for applying the Agricultural Adjustment Act to corn and hog production and marketing problems.

Dr. Joseph S. Ames, president of the Johns Hopkins University, arrived in New York on September 21, after a trip to Europe.

Dr. H. E. Jaques, head of the division of biological sciences at Iowa Wesleyan College, spent the summer in further work on the seasonal and geographic distribution survey of Iowa insects. Each of the ninety-nine counties of the state has now been covered in at least a preliminary way. Vincent Saurino, of New York City, among others accompanied the expedition.

DEAN FRANK D. KERN has received a year's leave of absence from the Pennsylvania State College and will act as head of the Agricultural College of Puerto Rico for the interim. He will also be required to consolidate and unify the heretofore independent departments of the Insular Experiment Station, the Isabela Station, demonstration farms and extension service, under the management of the college, as provided for by a recent act of the legislature.

DR. LAUGE KOCH, the Danish explorer, returned from East Greenland on September 25, bringing fossilized fishes of the Tertiary period.

DR. HENRY H. CLAY, lecturer at the School of Hygiene and Tropical Medicine in the Public Health Division of the University of London, has been making a study of the organization of public health administration in the United States.

DR. OTTO SZÁSZ, formerly professor of mathematics at Frankfurt, is this year visiting professor at the Massachusetts Institute of Technology. He was expected to arrive in Boston on September 30. During the winter he will deliver lectures on the summation of series.

PROFESSOR EDWARD KASNER, of Columbia University, will give a course of lectures on "Concepts of Modern Mathematics" at the New School for Social Research on Wednesdays at 8:20 P. M., beginning on October 4 and ending on November 8. His subjects will be: "Infinity," "The Fourth Dimension" and "Einstein."

THE Massachusetts General Hospital has invited Dr. Leroy M. S. Miner, dean of the Harvard Dental School, to deliver the Ether Day Address on October 16, the eighty-seventh anniversary of the first public use of ether in a surgical operation.

THE first autumn meeting of the New York Academy of Medicine on October 5 was dedicated to the memory of a young frontier physician, William Beaumont, whose researches on gastric digestion laid the foundation for all future work. An exhibit showing his original experiments was made at the meeting. Dr. Walter B. Cannon, George Higginson professor of physiology at the Harvard Medical School, made the main address. Other speakers were Dr. Bernard Sachs, president of the academy; Brigadier General Patterson, surgeon general of the Army, and Dr. Harris A. Houghton.

INVITATIONS have been accepted by the British Association to hold meetings of the association at Norwich in 1935, Blackpool in 1936 and Nottingham in 1937. As previously announced the meeting in 1934 will be held at Aberdeen from September 5 to 12.

THE Pilgrim Trust has appropriated the sum of £150 a year for five years to the British Association towards the maintenance of Down House.

THE Benjamin Franklin Memorial and Franklin Institute, Philadelphia, will open the planetarium section of its new building on November 1. The planetarium and planetarium chamber will be complete in every particular on that date and lectures will be begun immediately. The remainder of the building, with a nucleus of exhibits, will be opened to the public on December 5.

FOR some years past the California Academy of Sciences has arranged courses of lectures in the spring and in the fall on the general subject, "The Beauties of Nature." These lectures are made possible by the income from an endowment received from a friend of the academy. The course this fall will deal with subjects bearing on the geological history of the Pacific Coast. There will be lectures by Dr. R. D. Reed, chief geologist of the Texas Company, on October 18 and 25, on "An Extinct Volcano near Bakersfield" and on "The Origin of the Monterey Shale." Dr. B. L. Clark, of the paleontological department of the University of California, will lecture on the "Geological History of the Mount Diablo Region" on November 1, and on November 8 Dr. E. T. Hodge, professor of geology in the Oregon State System of Higher Education, will lecture on the "History of Columbia River." The endowment of the academy makes it possible to give these lectures free to the public.

THE Missouri Botanical Garden has acquired by bequest the herbarium and botanical library of the late Hon. Joseph Richmond Churchill, a distinguished and widely known Boston jurist and botanist. The herbarium consists of 12,000 to 15,000 specimens of ferns and flowering plants, which were collected by Judge Churchill himself. While the collections in large part were made in New England, yet many specimens were secured in the maritime provinces of eastern Canada, in the southeastern states from Virginia to Florida, in the central states of Indiana, Illinois and Missouri, and in the Rocky Mountain states of Wyoming and Colorado. Smaller collections also were obtained on journeys in Europe.

A CORRESPONDENT writes that a pot-hole has recently been discovered within five hundred feet of the summit of Burnt Rock Mountain, in Fayston, Vermont, at an elevation of 2,763 feet above sea-level. The pot-hole is at present four feet in diameter and two feet nine inches deep, but it was once much larger as shown by erosion remnants. The hole was evidently worn by glacial streams.

ARCHEOLOGICAL and anthropological sites have been identified in all but ten of the one hundred and twenty

counties in Kentucky by Professor W. S. Webb and W. D. Funkhouser, of the University of Kentucky, who have spent the last twenty years in excavations of this character. Of 1,255 sites 667 represent earth mounds, 21 shell mounds, 39 earthworks and fortifications, 162 camp and village sites, 170 cemeteries, 108 rock shelters, 57 inhabited caves and 33 such things as springs and licks, workshops, quarry sites, caches, pictographs and fish-traps.

The Rockefeller Foundation and Vanderbilt University are cooperating in a survey on hookworm disease in several counties in Mississippi in a special program promoted by the state board of health. A preliminary survey was conducted in Waynesboro and Wayne County.

The governor of Illinois recently appointed a commission of representatives of the State Department of Health to study the current outbreak of encephalitis in St. Louis. The four physicians are Drs. Hubert S. Houston, Springfield; Sandor Horwitz, Peoria; Henry Reis, Belleville, and William F. Grayson, Granite City.

According to the Canadian Press, Montreal University will close its doors on December 1 unless the Provincial Government makes necessary provisions for an annual $200,000 grant. A delegation which visited Premier L. A. Taschereau stated that the university was in grave difficulties in the financing of current expenses. This year's anticipated deficit is to be about $193,000. Back salaries are due professors for several months. The Prime Minister promised to place the request before the Cabinet Council. He pointed out, however, that an additional subsidy could only be granted at the next session of the legislature.

An Associated Press dispatch reports that an offer of a complete biological laboratory has been made to Montreal University by Copley Amory, of Boston, who established the laboratory several years ago. Whether university officials will accept the offer will depend on the report of Dr. P. Prefontaine, professor of the faculty of sciences, who is visiting the laboratory, which is at Matamek, Quebec, 300 miles east of Quebec City, on the north shores of the St. Lawrence. Conditions at the university do not warrant immediate acceptance of the laboratory, but an agreement may be reached by which it may be accepted when better times return.

Museum News reports that the New England Conference of the American Association of Museums will be held at Worcester, Massachusetts, October 20 and 21, with headquarters at the Bancroft Hotel. The first day's sessions will be held at the Worcester Art Museum, Lawrence Vail Coleman presiding, and at the Worcester Historical Society. In the evening there will be a subscription dinner, with an address by Paul J. Sachs, president of the association. On the second day the sessions will be at the John Woodman Higgins Armory, for discussion of art and industry, and at the Natural Science Museum. The late afternoon will be devoted to inspection of the library of the American Antiquarian Society. Delegates will be entertained at luncheon by the Worcester Art Museum and by John W. Higgins and at tea by the Worcester Historical Society. The committee in charge of the meeting consists of U. Waldo Cutler, executive director of the Worcester Historical Society, *chairman;* Francis Henry Taylor, director of the Worcester Art Museum, *secretary;* Harry C. Parker, director of the Worcester Natural History Society, and John W. Higgins, president of the John Woodman Higgins Armory.

The National Association of Audubon Societies has announced its acceptance of a suggestion made by John J. O'Rourke, Richmond Park commissioner, that about fifty acres of woods, fields and marshes in the southeastern part of New Springville Park, Staten Island, be set aside as the Staten Island Bird Sanctuary and managed by the association.

DISCUSSION

ARE GENES THE PRODUCT OF CROSSING-OVER

Although we are quite ignorant of the precise nature of genes, there is a pretty general consensus of opinion among geneticists that genes are very small, discrete bodies having a definite serial arrangement within or at least along the chromosomes and having the property, like so many little organisms, of producing other genes similar to themselves. It is now possible to make rough estimates of the dimensions of these minute bodies. We can not state with assurance that a gene consists of only a single molecule, although, according to some estimates, genes are not far from the size of some of the large protein molecules. We have commonly regarded genes as dividing by fission much as this process occurs in a whole chromosome, a plastid or any other small unit of living structure, and we have not troubled ourselves with the chemical changes which may be involved in this process. The multiplication of genes is thus put in the same category of biological phenomena as multiplication by fission in general. If we regard the gene

as a multi-molecular structure, we may let the matter rest, at least for the present, with this disposition of the case. If, however, we regard the gene as a single molecule, we are brought face to face with the problem of how a molecule may be conceived to reproduce itself. If we assume that the molecule divides by fission, each moiety will be different from the other, and each must be imagined somehow to regenerate, or form anew, the missing part. Here we encounter formidable difficulties. How the two parts of a complexly organized molecule can each reconstitute the missing part is not easy to imagine. We may escape this difficulty by supposing that genes do not really divide, but that they multiply by building copies of themselves out of the surrounding medium. If we suppose our molecule to have a configuration in three dimensions, we still have trouble in imagining how it can build up a similar molecule by its side Haldane has presented what, so far as I am aware, is the only intelligible picture of how a complex molecule can generate another, by supposing that it is organized as a sort of flat plate so that each atom or radicle might be supposed to attract to it corresponding atoms or radicles, and thus form a new molecule of a similar composition. A chain arrangement might of course duplicate itself in a similar manner. Thus a gene could produce other genes by a process which might fittingly be described as ectogenesis, although one hesitates to employ this term in a sense different from that in which it is used by the author of "Daedalus."

This view of the structure and propagation of genes naturally leads to the supposition, which has been made a number of times, that free genes constituted the most primitive forms of life, if indeed we are justified in applying the term living to self-perpetuating molecules of this kind. But whatever may have been the origin of genes, the hypothesis that genes represent single molecules receives a certain measure of support from the fact that gene mutations may be induced through occasional hits by electrons arising from exposure to x-rays and that the proportion of such mutations varies roughly with the time and the intensity of the exposure. One might contend, however, that similar results could be produced if genes consist of a relatively few molecules, and that gene mutations represent quantitative changes whose differential effects are caused by their varied rates of activity.

But leaving aside these very uncertain and possibly futile speculations as to the nature of genes, we may suggest an alternative supposition that genes, as we know them, are not primitive organic entities, but the product of a long series of evolutionary changes. We may suppose that in primitive organisms which have developed the essential mechanisms of sexual reproduction, including the conjugation of homologous chromosomes in synapsis, the chromosomes or the parts of them especially concerned in heredity, consisted of the same kind of substance throughout their length. A chromosome would then be more or less analogous to plastids and chondriosomes, which, at times at least, are known to multiply by a process of fission. The stages in the evolution of chromosomes among the primitive Protista are largely an unexplored field of cytology, but the supposition that chromosomes were homogeneous structures like other cell organs before they came to include diverse materials in their different parts is one that naturally commends itself on evolutionary grounds. In different strains of unicellular organisms it might be assumed that chromosomes would come to vary slightly in their chemical composition, as is probably the case with other cell organs. The development of crossing-over from the conjugation of homologous chromosomes is a very simple transition, but it is a step which greatly enhances whatever advantages may have been derived from amphimixis. As a result of one cross-over a chromosome may come to be composed partly of one substance and partly of a slightly different substance. By further cross-overs with other chromosomes of similar diverse composition we may conceive that the number of segments of slightly different composition would be continually increased. After crossing-over had been repeated for some millions of generations these segments would have long since become reduced to the smallest dimensions compatible with their continued perpetuation as individual units. In other words, they would finally become what we now talk about as genes. From this point of view, genes would represent the product of crossing-over, and the great diversity of genes in the individual organism a consequence of amphimixis.

The diversification of genes made possible through sexual reproduction has played an enormously important rôle in the evolution of life. Without sex, evolution has never proceeded beyond the production of relatively very simple organisms. Sexual reproduction not only enhances hereditary variability, but it makes possible the combination in one strain of the favorable variations which originated in a number of separate lines instead of merely one single line. Not only this, but it makes possible the accumulation of new characters arising from the interaction of different genes. Crossing-over affords the advantages of a sort of permanent heterozygosity by making possible the combination in a single chromosome of favorable groupings of different hereditary factors. Hence after the crossing-over mechanism was once evolved, nature would ever tend to diversify the genome.

Genes, as thus interpreted, represent the limiting stage in the diversification of the hereditary material.

Even if genes consist of no more than a single molecule they might still be considered to have originated in the manner indicated, because they would naturally tend to approach a certain minimal size, and this, so far as we know, may be molecular. If genes evolved in the way suggested according to this very simple hypothesis, we have a plausible explanation of why they came to have a serial arrangement in the chromosomes. On any other view this peculiar arrangement of genes would require subsidiary hypotheses for its explanation.

In accordance with this method of origin it might be expected that the process of quantitative reduction had not in all cases reached its final stage. One might suppose, as Goldschmidt has done, that the various multiple allelomorphs, such as those occurring in the locus for scute or for white eye in Drosophila, represent purely quantitative changes in the gene due to the loss (or gain) of one or more molecules. Genes vary greatly in the number of different forms they assume, and the readiness with which they undergo change. There are doubtless numerous genes which have never been observed to mutate, even in Drosophila, while there are a few which appear to mutate with riotous unrestraint. Evidently there are genes and genes. It might be that some genes have been reduced to molecular dimensions, whereas others are still multi-molecular and subject to a considerable degree of quantitative variability, albeit by discrete steps. For some reason the various phenotypic changes resulting from mutations occurring in a given locus are, to a considerable degree, interpretable as due to different rates of gene action. The doctrine of mere quantitative variations in genes has been almost entirely banished from genetics, after a due amount of controversy, and I would not venture to defend it in the form in which it was formerly advocated. If we adopt a quantitative theory of gene changes, it must be in some form which harmonizes with the discreteness of mutations.

S. J. Holmes

University of California

A NEW CORDAITES FROM MISSOURI

The occurrence of fossilized tree trunks in the Burlington limestone series of the Ozarks is quite rare.

When my attention was called to a fossil tree found last year by a farmer on his land near Springfield, Missouri, I made a preliminary study on March 30, and found a trunk, thirteen feet long and eight to ten inches in diameter, imbedded in a ledge of chert which is part of the Upper Burlington limestone series. The chert bed contains brachiopods, crinoids, bryozoans and other marine invertebrate forms typical of that time. The segment of tree evidently was imbedded after having been displaced from its normal position, and was weathered a great deal before induration of silica took place. All outer cortical tissues, leaves, roots and branches, such as might have been present, were lost before fossilization occurred.

Sections prepared on a petrotome to show transverse, radial and tangential aspects include to date only secondary wood. The stem was found to be considerably compressed, crushing much of the woody tissue, but leaving some areas unaffected. The following features are typical.

There is no evidence of annular rings or differentiation due to seasonal growth, a feature of Paleozoic secondary growth generally. The radiating wood rays are numerous and typically uniseriate, but occasionally they become biseriate. Tracheae are absent, so that the wood is made up entirely of tracheids. These in transverse aspect reveal a greater radial than tangential dimension, are quite square in outline and possess bordered pits on the radial walls only.

In the radial view the rays are seen to vary from one cell to twelve cells high. The border and central cells show no essential distinctive differences. Bordered pits connect the ray laterally with the tracheids. Bordering membranes are apparently limited to the tracheal side of the wall. These pits are ofttimes larger than adjoining tracheal pits. There are no pits joining the cells within the ray itself. The ray cells are smooth-walled and are devoid of the sculpturing commonly present in the Lepidodendrids of that period. The end walls of tracheids are long and tapering, with the end walls being radially disposed in such manner as to present the broad face in the radial view. The sloping end wall appears in the tangential view, where it is seen to bear pits of the same type as occur on the radial walls of the tracheid.

In the tangential view the linear series of bordered pits show on the radial and end walls, cut transversely. The tangential walls are devoid of pits. The occasional biseriate condition of the wood rays are evident in this view.

No distinctly scalariform or reticulate elements have been found, although the elongated bordered pits approach the scalariform marking and show all transitional forms between such condition and rounded borders. In all pits, however round the borders may be, the pit itself is elongated. The tracheids with rounded pit membranes are more or less irregularly distributed among those which bear elongated pits, the latter being much more numerous. The axis of the pits varies from horizontal to approximately vertical.

There is no observable thickening or torus on the membrane opposite the pits. Bars of Sanio, which are present in the Ginkgo and conifer forms, are conspicuously absent.

Preliminary examination would indicate a new species of cordaites for which I propose the name *Cordaites Missouriense.*

The destruction of central pith preceding induration and subsequent compression have destroyed the structural evidence which would have otherwise been presented by the central elements of the stele. It is hoped that, preceding a more extensive description of this form which I will submit soon, evidence as to the nature of the primary wood and pith might be found.

J. E. CRIBBS

DRURY COLLEGE

CLIMATIC CHANGE IN JAPAN

A PRELIMINARY report by Jimbo[1] indicates that recent changes in vegetation, and presumably in climate, near Mount Hakkôda in Japan correspond to those already established for Europe[2] and North America.[3] The results of stratigraphic studies of fossil pollen in peat are summarized by the author as follows:

> Pollen of *Abies,* which were found in a larger number in the upper layer, could scarcely be seen in the lower layers, while those of *Fagus* and of *Quercus* were abundant in the lowest layer, decreasing remarkably towards the surface. This fact may be considered as an evidence of predominant growth of *Fagus* and *Quercus* in older times, while *Abies* is dominant in the present time. It may be presumed, therefore, that deciduous forests in this region have been invaded by the montane conifer.

We have thus a new and important link in a chain of evidence almost girdling the northern hemisphere. Without serious exception this evidence points to a recent increase in coolness and humidity following a warm, dry period of three or four thousand years ago. It is interesting to note that on this point microstratigraphy has confirmed inferences based upon floristic study; for the value of floristics as a means of obtaining perspective in ecological work is perhaps not sufficiently appreciated.

PAUL B. SEARS

UNIVERSITY OF OKLAHOMA

FALL OF A METEORITE IN SOUTH CAROLINA

A NEW meteorite has just come into my possession. The stone, which weighs about twelve pounds, fell July 1, 1933, within a few feet of a church at Cherokee Springs, South Carolina. The fall was very satisfactorily observed by two intelligent men, who state that the stone, which was picked up immediately, was too warm to hold comfortably in the hand, though not hot.

It is roughly rectangular in outline, bounded by rather flat surfaces showing a rather striking absence of the usual pitting. A considerable broken area at one end shows it to be apparently a light gray spherulitic chondrite, with very strongly developed chondrules and conspicuous inclusions of troilite. One or two smaller broken spots show traces of a secondary fusion crust. The primary crust is for the most part intact and more than ordinarily thick. I am proceeding with a full description, which will be completed as soon as practicable.

STUART H. PERRY

THE ADRIAN DAILY TELEGRAM
ADRIAN, MICHIGAN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR DEHYDRATING NEMATODES

THERE is in use at the biological laboratory at New York University an instrument designed by the writer for the purpose of dehydrating nematodes which possess very thick cuticula. This structure, characteristic of many species of nematodes, especially the free living types, is very impermeable to dehydrating fluids, and therefore, if the change from an alcohol of a given percentage to one of a higher percentage is not carried out gradually, the nematode collapses. The apparatus to be described carries out these changes very slowly and needs little of the worker's time.

As shown by the figure, it consists of a series of five tubes set at an angle of about 30° onto a piece of glass tubing T about 550 mm long and 4 mm in diameter. All the glass tubes reach a height of about 700 mm above the bend G in the tubing. Each of the tubes is sealed to the tubing T by means of a large bore capillary. The capillary bore from tube 1 to tube 5 becomes increasingly larger; that is, the capillary of tube 1 is smaller than that of tube 2 which is smaller than that of tube 3, etc. The capillary of tube 1 has such a diameter that when the tube which rests on it, if full of water, will deliver the liquid at a rate equal to the rate of flow of water through capillary 2 when tube 2 is filled with water. Similarly, capil-

[1] Tadao Jimbo, "Pollen-analytical Studies of Peat Formed on Volcanic Ash," *Sci. Rep. Tohoku Imp. Univ.* 4th Ser. (Biol.), VII, 1: 129–132, 1932.

[2] G. D. Fuller, "Pollen Analysis and Postglacial Vegetation," *Bot. Gaz.*, 83: 323–325, 1927.

[3] P. B. Sears, "Postglacial Climate in Eastern North America," *Ecol.*, 13, 1: 1–6, 1932.

lary 3 has a bore through which water will flow, when tube 3 is full, at a rate equal to the flow through capillary 2, etc. Since the rate of flow depends chiefly on the height of liquid, exerting a pressure through the capillary, and since the tubes become progressively shorter, it is easy to see the reason for the increase in the bore of the capillaries. The tubing T leads to a cup Y, to the bottom of which is attached a U-shaped tube ending in a piece of rubber tubing, the opening of which can be adjusted by means of a pinch-cock.

To prepare the instrument for use, the following procedure is carried out: the nematodes are placed inside of the cup Y, the pinch-cock Z is turned to shut off the opening entirely, the cup is filled with water to the level L and it is then fitted to the stopper

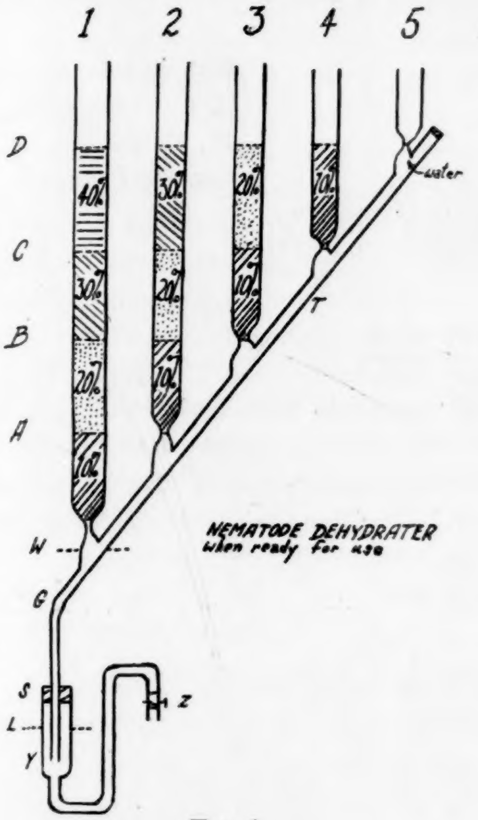

FIG. 1.

S, whereupon water is driven up the tubing to about the level W. Into tube 1 is now poured 40 per cent. alcohol until level A is reached in tubes 1 and 2. Into tube 2, 30 per cent. alcohol is now poured which pushes out the 40 per cent. alcohol from tube 2 and then flows under the 40 per cent. alcohol in tube 1 raising the liquid to the level B. There is now in tube 1 a lower layer of 30 per cent. alcohol upon which rests a layer of 40 per cent. alcohol, while in tubes 2 and 3 there is only 30 per cent. alcohol to the level B. Now 20 per cent. alcohol is poured into tube 3, which forces out the 30 per cent. alcohol from 3 and then rises under the 30 per cent. alcohol in tubes 2 and 1 until the level C is reached in tubes 1, 2, 3 and 4. There is now in tube 1 a lower layer of 20 per cent., a middle layer of 30 per cent., and an upper layer of 40 per cent. alcohol; in tube 2 there is a lower layer of 20 per cent. and an upper layer of 30 per cent. alcohol, while in tubes 3 and 4 there is only 20 per cent. alcohol. Into tube 4 is now poured 10 per cent. alcohol until the liquid in tubes 1, 2, 3, 4 and 5 reach the level D. There is now in tube 1 a lower layer of 10 per cent., a second layer of 20 per cent., a third layer of 30 per cent., and a top layer of 40 per cent. alcohol; in tube 2 there is a lower layer of 10 per cent., a second layer of 20 per cent., and an upper layer of 30 per cent. alcohol; in tube 3 there is a lower layer of 10 per cent. and an upper layer of 20 per cent alcohol; and in tubes 4 and 5 there is just 10 per cent. alcohol to the level D. Into tube 5 there is now poured a little water—enough to drive out the alcohol from tube 5 and to clear out the tubing T. The apparatus is now ready to be used.

The pinch-cock is opened and the liquid drains from all the tubes at once. First the 10 per cent. alcohol flows from tubes 1, 2, 3 and 4, leaving tube 4 empty; next 20 per cent alcohol flows from tubes 1, 2 and 3, leaving tube 3 empty; then 30 per cent. alcohol flows from tubes 1 and 2, leaving tube 2 empty; and finally 40 per cent. alcohol flows from tube 1, emptying it. The rate of flow and therefore the speed with which the nemas are taken up through the dehydrating fluids can easily be regulated by opening or closing the pinch-cock. The process is now repeated, using 50 per cent., 60 per cent., 70 per cent., 80 per cent. and 95 per cent. alcohols.

If the capillaries are made so that each will deliver about 50 cc a minute, the apparatus can be filled in about 7 minutes and need not be touched for the entire length of the run-up. The change from an alcohol of a given percentage to one higher up is very gradual, because the two alcohols, stratified as they are because of their different densities, nevertheless diffuse somewhat at the interface of the layers. If the nematodes are very small, a piece of chamois placed on the bottom of a plaster-of-paris cup, which can be molded to fit inside of the glass cup Y, may be utilized. The nemas, placed on the chamois through which alcohol readily passes, can be easily seen and handled.

PHILIP BERWICK

NEW YORK UNIVERSITY

CULTURE OF THE DRONE FLY, ERISTALIS TENAX

Eristalis tenax has been shown to be especially valuable for the study of its reactions to light,[1] because it is uniformly positive and orients accurately in light,

[1] W. L. Dolley, Jr., and H. G. Haines, *Scientific Monthly*, 31: 508, 1930; W. L. Dolley, Jr., *Jour. Exp. Zool.*, 62: 319, 1932.

is of large size and is hardy in captivity. It is also valuable for many other types of work

Previous attempts to rear it have proved unsuccessful. This organism has now been successfully reared for 19 months. In December, 1931, a female collected in the open the previous month laid eggs and from these a strain has been reared continuously since.

The flies are kept in wire cages, 15 × 15 × 15 cm, containing watch glasses filled with cheese cloth moistened with tap water. In these cages are also small wooden feeding troughs filled with a mixture consisting of equal parts of dry poppy, *Eschscholtzia californica,* pollen and powdered cane sugar. On this food the flies live perfectly and lay many fertile eggs.

The cages are kept before a laboratory window but are not exposed to the direct rays of the sun.

The eggs are collected and placed on human feces in a vessel also containing moist earth. Fresh feces are added daily. The larvae pupate in the soil.

At a temperature of between 20 and 25 degrees C., a typical female began laying eggs 10 days after emergence and laid about 3,000 eggs in about 60 days. The eggs hatch in about 36 hours after they are laid. The duration of the larval and pupal stages is about 2 weeks and 8 days, respectively, at about 22 degrees C. Oviposition has been observed at various temperatures between 20.5 and 30.5 degrees C.

The pollen can be purchased from the Knapp and Knapp Pollen Gardens, North Hollywood, California, or it can be raised. The poppy blossoms are collected each day. The anthers are clipped off with scissors and dried in the sun for 12 hours. The pollen separated from the dried anthers by means of a sieve with a fine mesh is kept in a desiccator over calcium chloride. Pollen rapidly deteriorates on exposure to moisture.

Since the methods for culturing it are comparatively simple Eristalis is now available for work throughout the year.

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SPECIAL ARTICLES

A NOTE ON THE STABILITY OF RESISTANCE TO COLDS[1]

It is knowledge derived from ordinary experience that persons under apparently uniform conditions of exposure are highly variable in respect to the number of colds suffered in a given period of time. For example, approximately twenty-five per cent. of college students have four or more attacks in an academic year while about the same proportion escape completely or have only one attack.

The distribution of the number of attacks suffered may be usually closely approximated by the terms of the expanded function,

$$N\left[\left(1-\frac{1}{N}\right)+\frac{1}{N}\right]^n,$$

where N is the number of persons in the population and n the total number of colds suffered by that population in the academic year. The first term of the expansion gives the number of persons expected to suffer no attack, the second term one attack, and so on. The probabilities involved are based clearly on the hypothesis that the colds are distributed by the operation of chance alone.

It is of interest to note that an exponential series like Poisson's may also be used to approximate the distribution of the number of attacks suffered. The series may be written,

$$e^{-m}\left(1+m+\frac{m^2}{2\,!}+\frac{m^3}{3\,!}+\ .\ .\ .\right),$$

where m is the mean number of colds per person in the academic year, and the successive terms of the product are the probabilities, respectively, of a person's being attacked 0, 1, 2, 3, . . . , times during the academic year. To obtain the number of persons expected to suffer 0, 1, 2, 3, . . . attacks it is obviously only necessary to multiply each term of the product successively by the population.

It is pertinent to ask if there is a characteristic persistence of resistance or susceptibility to colds with the passage of time. It is perhaps generally believed that persons who are infrequently attacked and who fall therefore well to the left of the mode of the distribution, and those frequently attacked who fall well to the right, are in their respective positions not by chance but because of possessing differing powers of resistance. And, although not supported by records of prevalence, these cold-resistants and cold-susceptibles are believed to remain in these categories for a period of years, and possibly for life. According to this conception there should be a high positive corre-

[1] From the John J. Abel Fund for Research on the Common Cold, and the Department of Biostatistics (Paper No. 188) of the School of Hygiene and Public Health, the Johns Hopkins University; and the Department of Hygiene and Bacteriology of the School of Medicine of Western Reserve University.

lation between the number of attacks suffered by a person in different periods of time.

In the studies of the Abel Fund there have become available for the first time requisite data to test this theory. The data are furnished by the Student Group and the Family Group. The first group comprising chiefly students in medicine of the Johns Hopkins University reported from September, 1928, to June, 1932, or four academic years. The second group containing about 100 families residing in Baltimore reported without interruption from November, 1928, to November, 1930. For the study of frequency of attacks in the same persons in two successive years there are the records of 155 students for the first and second years of the study, of 194 for the second and third years and of 54 for the third and fourth years. There were enrolled 114 students in the first year who also were enrolled in the third year, and 56 who reported both in the second and fourth years, thus affording data on the stability of resistance after an interval of one year. Also 49 students were observed in the first and fourth years, which permits analysis of possible change after an interval of two years. The Family Group makes available for two calendar years the records of 144 persons under fifteen years of age, and of 147 of fifteen years and over.

The analysis of these data is based on the computed Pearsonian product-moment coefficient r. The coefficients of the Student Group range from $.16 \pm .10$ to $.41 \pm .05$, and the coefficients yielded by the lower and upper ages of the Family Group are $.64 \pm .06$, and $.54 \pm .06$, respectively. The coefficients of both Student and Family Groups indicate that there is a tendency for persons to remain in the same cold-number class at least for successive years; when the years observed are separated by one year the results are doubtful, and when the interval is two years, a single observation indicates no definite tendency for persons to remain in the same class.

Further available data in the records useful to test stability of resistance and susceptibility comprise the results of continuous observation for three academic years of 111 of the students, and for four academic years of 45. The trend, in general, in each group of students, of the average yearly number of colds reported by those suffering few or many colds when projected into the future or back into the past is towards the average or mean yearly number reported by the total population. With reference to stability, whether of resistance or susceptibility, the data indicate that such a phenomenon was not characteristic of either group of students.

The report will appear in full in the November, 1933, issue (Epidemiological Number) of *The American Journal of Hygiene*. The bibliography will contain a check list of the publications from the John J. Abel Fund for Research on the Common Cold.

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EXANTHEMA IN PEARS AND ITS RELATION TO COPPER DEFICIENCY

In previous publications[1] it was shown that pear and other deciduous trees affected with Exanthema can be cured by application of $CuSO_4$ to the soil or to the trees.

In further work on this disease carried on recently it was found that treatments of Bartlett pear trees affected with the disease resulted in marked improvement following spraying with Bordeaux mixture, or after the introduction of soluble copper salts into the trunks of the trees. Similar treatments with iron citrate, manganese chloride and zinc sulfate, respectively, were without effect.

Analyses of leaves and twigs showed that the copper content of diseased leaves was lower than that of leaves from trees in a healthy section of the affected orchard and was considerably lower than that of leaves from localities free of the disease. The copper content, on dry weight basis, of leaf samples collected between June and October was as follows:

	Parts of copper per million
Leaves affected with Exanthema	3.1– 5.1
Normal appearing leaves from diseased trees	3.5– 4.9
Normal leaves from part of orchard free of the disease	5.6– 7.6
Normal leaves from localities free of the disease	11.0–20.0

These results strongly suggest that Exanthema in pear trees is due to a deficiency of copper. It should be added, however, that the copper content of healthy looking leaves from diseased trees does not vary significantly from that of the diseased leaves from the same trees. This relation is very similar to that obtained in plants affected with chlorosis due to a deficiency of iron, in which case green leaves often contain less than yellow leaves from the same trees. This relation can be explained by the larger amount of "active iron" in the green leaves.[2] Similarly, it may

[1] R. E. Smith and H. E. Thomas, "Copper Sulphate as a Remedy for Exanthema in Prunes, Apples, Pears and Olives," *Phytopath.*, 18: 449–454, 1928.

H. E. Thomas, "The Curing of Exanthema by Injection of Copper Sulphate into the Tree," *Phytopath.*, 21: 995–996, 1931,

[2] J. Oserkowsky, "Quantitative Relation between Chlorophyll and Iron in Green and Chlorotic Pear Leaves," *Plant Physiol.*, 8: 449–468, 1933.

be assumed that healthy leaves from trees affected with Exanthema contain more "active copper" than diseased leaves, although their total copper content may be smaller, or it could be assumed that the copper is more efficient in its function in healthy leaves, whatever that function may be. In any event, the fact remains that the copper content of leaves, whether diseased or healthy, from trees affected with Exanthema was found to be invariably lower than that of healthy trees in soils free of the disease.

While Exanthema in pear trees is due most likely to a deficiency of copper, no evidence is available at present to decide whether the disease is caused by a deficiency of copper *per se,* or indirectly, as, for example, by the action of copper in neutralizing the effect of soil toxins absorbed by the plant.

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THE HUMORAL EXCITATION OF THE NESTING INSTINCTS IN RABBITS[1]

OBSERVERS of animal life always remark on the skillful preparation made for the reception and care of the new-born. These activities are called instinctive and are considered to be purely nervous in origin and mechanism by the majority of physiologists. It is the purpose of this paper to suggest that the excitation of the nesting instinct may follow the injection of the urine of pregnant women.

The female rabbit living in the ground or in out-of-door cages is almost always seen to pull out the hair from her anterior body wall for a day or two before her young are "kindled." Immediately before delivery she fluffs or cards the fur with her claws until it is extraordinarily light and arranged so as to form a rounded nest. After each of the litter is born and the cord and placenta are eaten by the mother, the fur is loosely piled over the young animal (as protection against chilling and drying?).

The pulling out of large amounts of hair and the fluffing of it into a nest has sometimes been observed to follow sterile copulation or pseudo pregnancy induced by "hopping" or by mechanical stimulation. Such procedures likewise result in a transient corpus luteum formation. When, therefore, we observed nesting to follow the injection of the urine of a pregnant woman into an isolated doe, it appeared that the excitation of this instinctive behavior might well be the result of ovulation and corpus luteum formation.

A number of female rabbits were isolated for at least one month and then injected with the urine of pregnant women. A few others were injected with commercial extracts of the urine of pregnant women (Antuitrin S.) All were closely observed by repeated laparotomies for the occurrence of ovulation and corpus luteum formation and the nesting activity carefully noted. It was discovered that the animals which ovulated and developed corpora lutea showed definite loosening of the fur as determined by repeated combing tests. This occurred at the end of the second week following injection. The rabbits that developed pseudo pregnancies showed it again at the end of the third week, and the normally pregnant animals showed this second loosening at the end of the fourth week. The rabbits were seen to pull hair only when it was in a loosened condition, but all animals which showed loose fur did not pull it out.

Only seven of fourteen rabbits injected with pregnancy urine built nests. The commercial extracts all proved negative as far as the nesting activity was concerned, although they led to corpus luteum formation. In the pseudo pregnant animals nesting occurred at the end of the third week following injection.

These findings lead us to conclude that the loosening of the hair in the rabbit parallels the involution of the corpus luteum and that some additional factor is necessary for excitation of the nesting instinct. The latter activity can be induced in the absence of pregnancy and through the injection of the urine of pregnant women. The nature of this additional factor is now being studied.

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[1] From the department of physiology of the College of Medicine of the University of Cincinnati. Aided by a grant from the Committee on Scientific Research of the American Medical Association.

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